"Multi Tasking Engine Oils"

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Current Lubrication Requirements

Vehicle and equipment systems require a variety of lubricating oils, fluids and greases to satisfactorily operate. The lubricating oils and fluids needed differ widely in their performance because of the intended use and differing system requirements. For example, engine oils and gear lubricants differ not only in viscosity requirements but also in the required additives. Gear lubricants need additives to provide extreme pressure qualities inherent for hypoid gear systems whereas these qualities are not needed for engine oils. Likewise, automatic transmission fluids require a different type of friction modification that is not required for either gear lubricants or engine oils. Additionally, automatic transmission fluids have a greater need for seal conditioners among other things to insure elastomer components do not dimensionally change with use.

The evolving nature of the automotive industry (e.g., increasing power density of engines, more computer assisted power-train functions, greater use of non-metallic components to decrease vehicle weight, etc.) coupled with new and more challenging environmental regulations has markedly changed the lubrication requirements for these engine oils, gear lubricants, and fluids over time. These changes have resulted from the need to accommodate higher engine operating temperatures and combustion pressures, extending frequencies of drain intervals, improving fuel economy and engine efficiencies, reducing overall emissions, accommodating higher levels of exhaust soot, etc. In addition, the introduction of new engines, power-train, and hydromechanical systems (e.g., the Constant Variable Transmission) has caused an increase in the number of engine oils, gear lubricants, automatic transmission fluids, and other special purpose fluids and oils within the marketplace.

The extensive degree of this product specialization (i.e., engine oils, gear lubricants, automatic transmission fluids, and other special purpose fluids and oils) is best understood by reviewing the recommendations different manufacturers provide in their individual owners manuals. Motor Information Systems publishes annual summaries of automotive lubrication requirements called "Chek-Chart." A copy of their "2005 Lubrication Recommendations Guide[1]" reviewed the following: twenty-two types are listed under Engine Oils, ten types are listed under Gear Lubricants, fourteen types are listed under Automatic Transmission Fluids, three types are listed under Manual Transmission Oils, four types are listed under Hydraulic Fluids, twenty-one types are listed under Power Steering Fluids, and thirty-seven types are listed under Special Lubricant-Fluids. Within this latter group (i.e., Special Lubricant-Fluids), there exists even further specialization as many of the lubricant-fluid products are individually listed as a manufacture's part numbered item.

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Vehicle and equipment systems require a variety of lubricating oils, fluids and greases to satisfactorily operate. The lubricating oils and fluids needed differ widely in their performance because of the intended use and differing system requirements. For example, engine oils and gear lubricants differ not only in viscosity requirements but also in the required additives. Gear lubricants need additives to provide extreme pressure qualities inherent for hypoid gear systems whereas these qualities are not needed for engine oils. Likewise, automatic transmission fluids require a different type of friction modification that is not required for either gear lubricants or engine oils. Additionally, automatic transmission fluids have a greater need for seal conditioners among other things to insure elastomer components do not dimensionally change with use.

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Problems due to Changing Requirements, Logistics/Supply, and Potential for Misapplication

Having multiple products being required obviously generates potential problems for the consumer due to the constant changes in performance requirements. Engine oils in particular are those that have been experiencing the greater number of changes resulting from environmental regulations, newer engine designs, and the need to meet consumers' desire for improved performance, such as, longer drain intervals (e.g., up to 15,000 miles) and increased fuel economy. This has created a new issue involving the need for engine oils to be backwards compatible; that is, able to be used in older engines as well as the newer engines. In the past, this was not a major problem as all engine oils were generally backwards compatible. However, with the more stringent requirements being imposed to meet future emissions standards (e.g., lower levels of sulfated ash, lower volatility, etc.), this need surfaced and has required considerable engine testing to insure the legacy engines will not be adversely affected when using the newer oils. Having to stock and manage multiple engine oils creates problems in terms of misapplication (e.g., the greater the number, the more potential for error), the increased infrastructure costs needed to store and distribute these products, the higher costs due to smaller volume purchases, and increased disposal costs.

Obviously, engine oils having multi-purpose applications (e.g., multi tasking) would certainly help to eliminate the types of problems mentioned above. However, the difficulties arise from having to meet multiple engine and other requirements which typically would require increased additive treatment as well as additional types of additives. These higher treatment levels and additives may lead to possible compromises in the oil quality[2] as well as potential additive interactions that can be anti synergistic.

Industry's Reluctance towards Universal Lubricants

In the past, there have not been any significant efforts by industry directed towards developing and marketing an engine oil that would be able to perform multiple functions. This hesitancy more than likely is the result of the increased developmental costs to overcome the many anticipated obstacles such as balancing the additives needed to cover multiple performance requirements, developing additives that would provide multi functional capabilities, etc. Additionally, the customer acceptance for such a product would require a considerable degree of marketing to insure that each individual performance requirement was fully met and not compromised. There has been some limited progress within the agricultural industry in this area. In 1980, a paper reported on the development of a multi use engine oil for farm tractors[3] which satisfied requirements for the engine, transmission, gear system and hydraulics. Although this represented a start in multi tasking engine oils, the momentum did not progress further.

Part of this reluctance has been a result of how the industry operates. There seems to be an opinion that in marketing a greater number of individual products, greater profit margins will be the end result. Unfortunately for the consumer, that increases the overall operating costs for those vehicle or equipment involved. Another integral part of this

equation is the tendency of some original equipment manufactures (OEMs) to promote their individual products. This was evidenced in a recent article regarding gear lubricants[4] which indicated recent trends in automotive gear lubricants. These trends were (1) the move to special OEM-approved extended-drain lubricants and, (2) the control of lubricant sales by the OEMs themselves. Although these trends were primarily for gear lubricants, similar trends would follow for engine oils as was evidenced in the listing of products in the Chek-Chart document mentioned previously. For example, several manufacturers of heavy duty trucks list their OEM approved engine oils as either being mandatory or highly recommended in their service bulletins.

Army's Past Efforts involving Universal Lubricants

For years, the Army has been a major supporter for multipurpose or universal engine and power-train oils. The driving force behind this effort has been to minimize both the logistics and supply requirements for its ground fleet of vehicles and equipment, and to lessen the chances of maintenance mistakes that might occur due to misapplication. Coupled with this has been the mandatory requirement of flexibility for the logistics and supply systems due to the nature of military operations (i.e., the necessity to provide for many different types of vehicles and engines operating in both widely differing environmental conditions and operating modes). The Army's "bread and butter" engine oil, Performance Specification MIL-PRF-2104H (Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service), has served this role well over these past many years. Oils meeting this specification are not just intended for lubricating internal combustion engines, but also are used in powershift transmissions, hydraulic systems, and non-hypoid gear systems of engineer/construction equipment, materials handling equipment, and all types of combat/tactical ground equipment.

The expanded use of the above specification has been the result of the Army's desire to minimize the numbers the different lubricant specifications. Wherever possible, automotive specification products are used in as many applications as possible realizing that some performance trade-offs would be accepted in favor of reduced logistics. In keeping with this trend, Military Handbook MIL-HDBK-838 (Lubrication of Military Equipment) has provided guidance to the Army and the other services recommending equipment manufacturers use standard lubricants such as MIL-PRF-2104H and others. Nonstandard lubricants can only be approved when the contractor indicates that his particular vehicle or equipment will not satisfactorily perform when using a standard lubricant. Unfortunately, this has been relatively difficult to enforce as contractors typically cite safety or warranty concerns if they cannot specify their particular brand name proprietary product. In citing these concerns, rarely have contractors ever provided any testing documentation (i.e., standard lubricant versus nonstandard lubricant) that would support their concerns.

One such example of a warranty concern occurred in the mid 1970's during procurement of the John Deere 410 Loader Backhoe as part of the Army's Commercial Construction Equipment (CCE) program. Under this program, the Army adopted a policy of procuring "off-the-shelf" commercial CCE. Recognizing that many of these items had supplier-

imposed lubrication requirements, the Army had approached the ASTM's Committee D2 on Petroleum Products and Lubricants in 1974 to see whether a multipurpose hydraulic fluid specification or standard could be developed considering the significant number of proprietary hydraulic-transmission fluids that existed. No agreement was reached as each equipment manufacturer preferred their individual proprietary fluid and maintained that using the military's primary engine oil as a hydraulic and transmission fluid would create problems. The contract award to John Deere and Company in 1975 for the 410 Loader Backhoe. This introduced the first wet-brake equipped commercial vehicle into the Army's inventory which was accompanied by the requirement to use John Deere's JDM-J20A Transmission and Hydraulic Fluid as a fielded lubricant. Recognizing the potential application of the combat/tactical engine oil, the Army proceeded to determine whether this military engine oil would provide equivalent performance to the JDM-J20A fluid. The results of these laboratory bench, wet-brake, full-scale wear tests, and field evaluations subsequently revealed[5] the military engine oils to not only be equivalent to the JDM-J20A fluid, but in many instances superior. More recently, this concern in using engine oils for wet brake application again surfaced with the Deployable Universal Combat Earthmover (DEUCE). The manufacturer maintained that although these systems could tolerate the combat/tactical engine oil, continual using the engine oil could decrease the life of these systems due to the lower coefficients of friction of the military's engine oil. However, the manufacturer never provided any data to support their claims.

Apart from the questioned use of engine oil for wet-brake clutch applications, the Army has and continues to use wherever possible engine oils in more than one application. Engine oils are used in manual clash-type transmissions, transfer cases, power steering pumps, hydraulic systems, automatic and power-shift transmissions. Reviewing any Lubrication Order document will reveal numerous locations on vehicles and equipment where engine oil is specified in addition to the engine crankcase. These Lubrication Orders, commonly referred to as Lube Orders (LO), accompany each individual vehicle or equipment and provide the necessary instructions as to types and quantities of all lubricants needed, the lubrication points and what products are to be used, lubrication intervals and man-hours needed, etc. For example, the LO for the M911 Heavy Equipment Transporter (LO9-2320-270-12) specifies engine oil to be used not only in the engine, but also the auxiliary transmission, transfer case, automatic transmission, hydraulic reservoir, and steering system. On the other hand, the LO for the commercially procured (i.e., off-the-shelf) M1008 Tactical Cargo Truck 1-1/4 ton (LO9-2320-289-12) commonly called the Commercial Utility Cargo Vehicle specifies Dexron II automatic transmission fluid for the transmission, transfer case, and power steering pump and reservoir. This again illustrates the difference between military designed vehicles versus those that are procured commercially wherein the contractor generally has the final answer in what lubricating oils and fluids are to be used.

Recent Attempts promoting Lubricant Consolidation

There has been some effort within the farm and agricultural industries to promote and encourage the use of an engine oil having multiple functions. One manufacturer advertises their "Universal Oil" that is designed to be used in a variety of heavy duty

diesel and gasoline engines, powershift transmissions, and general hydraulic applications whereas another recommends a premium multifunctional tractor oils for farm machinery, lubricating naturally-aspirated or turbocharged diesel engines, transmission, hydraulic and immersed wet brake systems. Most tractors now use a common reservoir for transmission, hydrostatic, hydraulic and final drives. The lubricant formulators have developed a specific class of engine oils called Universal Tractor Transmission Oils (UTTOs) to satisfy this consumer market. Unfortunately, there are no industry-wide standards for these UTTOs as the American Petroleum Institute has standards for engine and gear oils but none for multipurpose lubricants of the type described above.

The concept of lubrication consolidation has recently surfaced as a means to reduce maintenance costs, extend equipment life and to simplify the purchasing process[6]. Although this has been primarily directed to plant machinery where significant numbers and types of lubricating oils and fluids exist, some of the methodology would more than likely be applicable to heavy-duty vehicles and equipment.

A Possible Way Ahead

To the average consumer, proliferation of OEM proprietary lubricants and the increasing trends towards specific products may be little more then a nuisance. But to large fleet owners with equipment manufactured by many different OEMs, this proliferation becomes a major problem. Not only is it a logistics burden, but it could potentially effect equipment reliability and durability if incorrect oils are accidentally used or simply not available when needed. For some situations (e.g., military combat and tactical equipment), these "nuisances" can lead to serious consequences such as decreased readiness and mission failures. Therefore, one strategy might involve large fleet owners forming an association to request suppliers/OEMs standardize on lubricant performance and design equipment to accommodate a wider range of lubricant formulations. Only a large association of end-item-users would have this type of power and unfortunately, this would be difficult to organize.

A second alternative would be to solicit the support of standardization organizations like the American Society of Testing and Materials (ASTM) or the Society of Automotive Engineers (SAE). These organizations have been fairly successful in the areas of engine and gear lubricants. Unfortunately as stated earlier, past attempts at garnering the support and consensus of all the interested stake holders (e.g. OEMs, lubricants suppliers, and additive formulators) have left the end-item-user empty handed. That being said, standardization organization need data to render decisions. If end-item-users are unwilling to contribute towards establishing test procedures, limits and precision, no amount of support or consensus will ever deliver the needed standard.

A third option for a large fleet owner like the Army would be to competitively bid a single contract to supply all its combat and tactical power-train lubricant needs to a single additive formulator, thus providing them with an incentive to invest in the needed research and development to make a truly versatile, high performance, multifunctional fluid meeting the requirements of as many OEMs as possible. This would be a dramatic

change from the Army's current system of procurement where multiple contractors supply a variety of products.

A final option would be for the Army to step away from its long time association with multi tasking engine oils altogether and embrace a different approach. Not surprisingly, this was strongly supported by both OEMs and lubricant manufacturers/suppliers when the Army conducted a survey in August of 2002 to gage their opinions on current and future trends affecting military ground equipment. The overwhelming reasons given for the separation of the engine and transmission requirements included the ability to optimize component durability and performance, formulate for longer drain intervals, and reduced formulation costs.

Either way, if current trends toward OEM proprietary products continues in their current direction, large fleet owners like the Army that rely on multi tasking engine lubricants must takes steps to guarantee their own interests. This could come in the form of a drastic change in procurement policy, stepping away from multi tasking lubricants and their benefits, or an increase in research and development to ensure that qualified products are meeting the needs of all combat and tactical equipment.
[2,585]

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